by Mike Richardson

Life in Mauna Kea's Alpine Desert

*H*igh above the sunny beaches, rocky coastline, and lush, tropical forests of the Big Island of Hawai'i lies a unique environment unknown even to many residents. The harsh, barren, cold alpine desert is so hostile that it may appear devoid of life. However, a few species existing nowhere else have formed a precarious ecosystem-in-miniature of insects, spiders, other arthropods, and simple plants and lichens. Welcome to the summit of Mauna Kea!

Rising 13,796 feet (4,205 meters) above sea level, Mauna Kea is the highest island mountain in the world. It is a gigantic classic shield volcano, and the broad landscape of its summit is an alpine desert composed of cinder cones on a lava plateau. The upper summit forms an alpine lava community sparsely vegetated with leafy lichens and moss. Prior to the 1980s, most people believed the summit was essentially a lifeless desert. However, starting in 1979 with the discovery of the wekiu bug *(Nysius wekiuicola)*, an entire aeolian (wind-dependent) community of arthropods was uncovered at the summit.

Aeolian ecosystems are usually found within alpine deserts. They are characterized by a low number of primary producers, except for a few algae, mosses, and lichens, and a community of mostly arthropod predators and scavengers that feed on organisms blown up from lower elevations. The unique aeolian ecosystem on Mauna Kea's summit is composed of at least 12 endemic arthropods, including omnivorous, day-flying *Agrotis* moths, voracious *Lycosa* wolf spiders, a centipede that preys on moribund insects that are blown to the summit, and the unique, flightless wekiu bug.

A candidate for federal listing as an endangered species, the wekiu bug was first discovered in 1979 by entomologists on Pu'u Wekiu, the summit cinder cone. "Wekiu" is Hawaiian for "topmost" or "summit." The wekiu bug belongs to the family Lygaeidae within the order of insects known as Heteroptera (true bugs). Most of the 26 endemic Hawaiian *Nysius* species use a tube-like beak to feed on native plant seed heads, but the wekiu bug uses its beak to suck the hemolymph (blood) from other insects. Excluding its close relative *Nysius a'a* on the nearby Mauna Loa, the wekiu bug differs from all the world's 106 *Nysius* species in its predatory habits and unusual physical characteristics. The bug possesses nearly microscopically small wings and has the longest, thinnest legs and the most elongated head of any Lygaeid bug in the world.

The wekiu bug, about the size of a grain of rice, is most often found under rocks and cinders where it preys diurnally (during daylight) on insects and even birds that are blown up from lower elevations and have died of exposure. Both nymph and adult wekiu bugs remain active all year, and use snow to their advantage by feeding on insects that are either preserved or immobilized by the cold. They emerge from the cinders to feed and mate when the sun has warmed the rock surfaces, particularly at the margins of snow fields. Apparently, they will remain along the narrow melting perimeter of a snowfield to take advantage of any frozen insects that drop from the receding snowfield.

Should a shadow cross the sun when wekiu bugs are foraging in this moist, food-rich habitat, they will quickly retreat deep into the cinders.

Threats to Mauna Kea Arthropods

Because of ideal atmospheric qualities and weather conditions, the University of Hawaii's Institute for Astronomy has developed the summit as the Mauna Kea Science Reserve for astronomical study. Environmental impacts include road construction, parking areas, tourist facilities, temporary storage areas, substrate removal, oil spills, and constant traffic to the summit (with the resulting trash and debris). Tephra cinders, the preferred substrate of the wekiu bug and other Mauna Kea arthropods, are easily crushed into dust-sized particles, and vehicular traffic can quickly change a rocky cinder habitat to one of compacted silt and mud. Since 1963, when the first modern road was bulldozed to the summit, some researchers estimate approximately 62 acres (25 hectares) of potential arthropod habitat have been lost to astronomy-related development on the summit. Currently, more than two thirds of the wekiu bug's potential range is unprotected from this development.

The wekiu bug now competes for prey with at least one introduced species of Linyphiidae spider (small sheet web spiders) that has become established on the summit. Furthermore, global warming may potentially threaten all of the endemic Mauna Kea arthropods. The summit has been warmer and has had reduced snowfall since 1982. In addition, if available habitat is seriously reduced by summit development, the wekiu bug will likely be less capable of responding and surviving during climatic changes.

Protecting Mauna Kea Arthropods

A Candidate Conservation Agreement (CCA) to provide long-term protection for endemic Mauna Kea arthropods, including the wekiu bug and its habitat, is in the early planning stages. The Fish and Wildlife Service's Pacific Islands Ecological Services Office is developing the CCA to facilitate voluntary cooperation with the Office of Mauna Kea Management (the state office that oversees activities and development), the University of Hawaii Institute for Astronomy, and the numerous agencies and organizations involved in astronomical activities on the Mauna Kea summit.

Wekiu bug
Photo by Dr. Bill Mull

(Opposite page) Sunset at the alpine desert of Mauna Kea's summit
Photo by Mick Castillo/USFWS

Such protection will include monitoring of species status trends and habitat quality, removing some of the known threats, educating field personnel and permittees, habitat restoration, and incorporating species conservation measures into planning and management activities. If successful, this CCA would remove the need to list the wekiu bug under the Endangered Species Act and would also conserve several other endemic species, including the wolf spider and the *Agrotis* moths. The CCA complements the Pacific Islands Office's Ecosystem Conservation Plan for preservation, protection, and management of native habitat on the summit of Mauna Kea, which the plan has identified as a Biodiversity Landscape.

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